ELECTRIC VEHICLE WITH MODULAR REMOVABLE AUXILIARY BATTERY WITH INTEGRATED COOLING

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 62/531,847 filed Jul. 12, 2017, the entire contents of which are incorporated herein by reference.

BACKGROUND

Field of the Disclosure

[0002] The present disclosure relates to vehicles, such as electric vehicles including hybrid vehicles, and more particularly to an auxiliary battery system for electric vehicles.

Background Information

[0003] Electric automotive vehicles are of great interest for transportation applications and can provide benefits of low or zero emissions, quiet operation and reduced dependence upon fossil fuels. However, the range of typical electrical vehicles may be insufficient for some uses. The present inventors have observed a need for an improved approach for providing extended range for electric automotive vehicles.

SUMMARY

[0004] The present inventors have observed a need for an auxiliary battery system for an electric automotive vehicle to increase the range of the electric vehicle, and in particular, an auxiliary battery system that can be carried by the electric vehicle, e.g., in a cargo area of the electric vehicle, and that can be efficiently cooled. The present disclosure describes an exemplary electric vehicle system including an electric vehicle and an auxiliary battery module that can be easily attached to, removed from and reattached to the electric vehicle as desired, and that can be cooled by sharing coolant of the electric vehicle's cooling system that cools the vehicle's primary powertrain electric battery. For example, liquid coolant such as ethylene glycol can be circulated through cooling lines (conduits) in the primary powertrain battery and through cooling lines in the auxiliary battery module to cool both the primary battery and the auxiliary battery, wherein, e.g., the liquid coolant for the primary power train battery and the liquid coolant for the auxiliary battery module are both cooled by a shared heat exchanger that exchanges heat between the coolant and a refrigerant. The present disclosure also describes an exemplary electric vehicle system including an electric vehicle and an auxiliary battery module that can be easily attached to, removed from and reattached to the electric vehicle as desired, and that includes its own separate and distinct refrigerant-based cooling system. When outfitted with the auxiliary battery, the electric vehicle can detect the fact that the auxiliary battery is attached to (e.g., mounted in) the electric vehicle (e.g., in cargo bed) and automatically set one of multiple predetermined feature sets, e.g., that pertain to driving performance of the electric vehicle. Such feature sets may set, for example, certain suspension characteristics appropriate for the attachment of the auxiliary battery, such as, e.g., a setting for firmness of ride of the vehicle, braking performance/sensitivity, nominal suspension height, effective steering ratio, etc. Exemplary approaches described herein may provide for both integrated cooling of the auxiliary battery and adjustment of settings that govern the ride performance of the electric vehicle when the auxiliary battery module is attached to (e.g., mounted in) the electric vehicle.

[0005] According to an example, an electric vehicle system for transporting human passengers or cargo includes an electric vehicle that includes a body, a plurality of wheels, a cargo area, an electric motor for propelling the electric vehicle, and a primary battery for providing electrical power to the electric motor for propelling the electric vehicle. The electric vehicle system also includes an auxiliary battery module that is attachable to the electric vehicle for providing electrical power to the electric motor via a first electrical connector at the auxiliary battery module and a second electrical connector at the electric vehicle that mates with the first electrical connector. The auxiliary battery module is configured to be positioned in the cargo area while supplying power to the electric motor, and is configured to be removable and reattachable from the electric vehicle. The auxiliary battery module includes an integrated cooling system for cooling the auxiliary battery module during operation of the electric vehicle, the integrated cooling system including a conduit for circulating coolant within the auxiliary battery module.

[0006] According to an example, an auxiliary battery module for providing electrical power to a powertrain of an electric vehicle for transporting human passengers or cargo is described. The auxiliary battery module includes: a battery housing; a battery disposed in the battery housing; support portions at the battery housing configured to securely mount the battery housing of the auxiliary battery module to support members of an electric vehicle at a cargo area of the electric vehicle using releasable fasteners or latching mechanisms to permit the auxiliary battery module to be removed from and reattached to the electric vehicle; a first electrical connector at the battery housing and electrically connected to the battery disposed in the battery housing, the first electrical connector configured to mate with a corresponding second electrical connector at the electric vehicle to permit the auxiliary battery module to power a powertrain of the electric vehicle to propel the electric vehicle; and an integrated cooling system inside the battery housing for cooling the auxiliary battery module during operation of the electric vehicle, the integrated cooling system comprising a conduit for circulating coolant within the auxiliary battery module.

[0007] According to an example, a method of utilizing an auxiliary battery module with an electric vehicle, the electric vehicle suitable for transporting human occupants or cargo, is described. The method includes attaching an auxiliary battery module to an electric vehicle, the auxiliary battery module being configured to be removable from and reattachable to the electric vehicle, said attaching comprising electrically connecting the auxiliary battery module in parallel with a primary battery of the electric vehicle; providing electrical power from the auxiliary battery module to an electric motor of the electric vehicle via a first electrical connector at the auxiliary battery module and a second electrical connector at the electric vehicle that mates with the first electrical connector for propelling the electric vehicle; monitoring a temperature of the main battery of the electric vehicle and a temperature of the auxiliary battery module; and cooling the auxiliary battery module based on said monitoring with an integrated cooling system of the